Maternal MORTALITY REPORTS

These case reports are taken from the files of the State Department of Public Health which, together with the California Medical Association, now sponsors the statewide studies of all maternal mortalities. Selected cases are here presented from time to time as a matter of interest and illumination to all physicians concerned with the practice of obstetrics. They are prepared by the Committee on Maternal and Child Care. It is hoped that a review of such significant cases will help to improve the welfare of future California mothers.

CASE NO. 5

THIS PATIENT was a 33-year-old Mexican, gravida 4, para 1. Following two spontaneous abortions she carried a pregnancy to term two years before her death. She was delivered by cesarean section after a pregnancy said to be 44 weeks, and the infant weighed 12 pounds but was stillborn. Approximately six months later a diagnosis of diabetes mellitus was made and the patient was maintained on a moderate dosage of insulin.

During the current pregnancy the patient was seen from the third month of gestation onward, with weekly visits alternating between an obstetrician and an internist. Insulin dosage ranged between 80 and 100 units daily, type not specified. The patient cooperated poorly in her medical regimen, and control of the diabetes was reported as "difficult." "Excessive" weight gain occurred, but no other signs or symptoms of toxemia developed.

The patient was first admitted to the hospital at the 36th week of pregnancy for evaluation of the diabetes and for elective cesarean section and was observed for three days before operation. The only blood sugar determination, two days before operation, was 22 mg. per 100 cc., and at this time the CO_2 combining power was determined at 12.5 mEq. per liter. Urinalysis was negative for protein, sugar, or significant microscopic findings. The blood pressure was 100/60 mm. of mercury. Hemoglobin content was 9.4 gm. per 100 cc. of blood and the packed cell volume was 30 per cent. There is no record of any iron therapy or of preoperative transfusion.

A half hour before cesarean section, 25 mg. of promethazine (Phenergan®) and 0.4 mg. of scopolamine, were given. At this time also, 80 units of lente insulin was administered. Intravenous administration of glucose solution (5 per cent in water) was started just before induction of anesthesia.

Spinal anesthesia was then induced with 15 mg. of tetracaine (Pontocaine®) given with the patient in sitting position. She was then placed in Trendelenberg position. Almost immediately she became very pale, air-hunger developed and the pulse became "very rapid." At once her position was leveled and oxygen administration with bag breathing was attempted. By this time the blood pressure was unobtainable. Almost simultaneously the following measures were employed: (1) one ampule of Vasoxyl® (methoxamine hydrochloride) intravenously and one ampule intramuscularly; (2) 30 ml. of 50 per cent glucose intravenously; (3) one ampule of levarterenol bitartrate (Levophed®) added to the intravenous infusion; (4) endotracheal intubation with 20 mg. of diacetylcholine (Anectine®) used as a relaxant; (5) within the hour after initial shock, 40 mg. of metaraminol (Aramine®) and "more" Levophed® added to the infusion. Fetal heart tones disappeared soon after the initial development of shock.

One hour after induction of anesthesia, the blood pressure was again measurable at 90/50 mm. of mercury, and soon it rose to 135/100 mm. The pulse rate reached 120, and the patient became hyperactive. The endotracheal tube was then removed—one and one-half hours after initial anesthesia. Shortly thereafter signs of acute pulmonary edema developed, and the patient again went into shock. Endotracheal intubation was reinstituted and vasopressor agents were again given, as well as desacetyl-lantoside (Cedilanid®), hydrocortisone (Solu-cortef®), meralluride (Mercuhydrin®) and chlorothiazide (Diuril®). From the onset of anesthesia, a total of 2,600 ml. of intravenous fluids had been given, but blood transfusion is not mentioned. Despite these measures, the patient did not recover from shock and died two hours and 20 minutes after induction of spinal anesthesia. An electrocardiogram obtained just before death suggested a high blood potassium level. There were no convulsions at any time. At autopsy the following significant observations were made: (1) diabetes mellitus, severe (sugar content of postmortem blood, 1,520 mg. per 100 cc.); (2) evidence of shock and cardiovascular failure; (3) acute pulmonary edema, minimal; (4) hyperpotassemia—10.5 mg. per 100 cc. in clear, nonhemolyzed postmortem serum.

COMMENT

This case presents a considerable array of items calling for comment.

1. This patient's first term pregnancy produced a 12-pound infant, stillborn. Even though the duration of that pregnancy was said to have been 44 weeks, this should not have lulled the suspicions of the attending physician regarding the possibility of maternal diabetes, for postmaturity alone cannot bring about excessive fetal size. It is generally agreed that the delivery of a first or second child weighing more than 10 pounds warrants reasonably prompt maternal investigation for diabetes. Unexplained stillbirth makes the indication more imperative.

2. This pregnant diabetic patient was first admitted to the hospital at the 36th week of pregnancy. With certainty of good control of the diabetes, outpatient management of such patients is acceptable. When, however, there is the slightest difficulty in maintaining good control, or if the patient is a juvenile or "fragile" diabetic, it is highly advisable to admit the patient to the hospital for study *early* in pregnancy in order to establish a diabetic regimen in meticulous detail—and maintenance of control may indeed require several admissions during the course of pregnancy.

From this point of view, care was considerably less than ideal for this patient, for at the time of her admission she was hypoglycemic and acidotic. Moreover, despite these worrisome laboratory findings, only a single determination of blood sugar and of CO_2 combining power was done. Obviously, the in-hospital study was grossly inadequate to obtain even adequate diabetic control, as was the short preoperative period of only three days—especially for a patient slated for a major surgical procedure.

3. Not only was preoperative preparation from the diabetic point of view poor, but operative risk was compounded when no attempt was made to correct the anemia before operation. Certainly no patient should undergo an elective cesarean section with a hemoglobin level of only 9.4 gm. per 100 cc. and packed cell volume of 30 per cent. Transfusion is urgently indicated in such circumstances.

4. Next, one might mildly question the propriety of using promethazine before operation in a patient with a blood pressure of only 100/60 mm. of mercury and due to have a spinal anesthetic. Even a mild hypotensive effect from it could well start a disastrous chain of events.

5. The advisability of giving the patient's full daily insulin dosage just before operation is questionable. We have no knowledge of the glycosuria status of the patient in the present case, but in general it is good practice to have the patient "spilling" some sugar at the time of operation. If a full dosage of insulin is then given, large amounts of intravenous glucose solution must be administered. This patient did receive her full dosage just before operation, and 5 per cent dextrose solution was started intravenously, but not until the advent of shock was extra glucose given. It is probable that hypoglycemia and acidosis contributed materially to the degree and persistence of shock. Both tend to produce vasodilatation, which would reinforce the other shock-producing factors in this patient (see below). And it may well be that these vascular influences were added critical factors in the production of a vascular collapse which responded so poorly to vasopressor agents and terminated in irreversible shock.

6. The principal responsibility for the shock, however, must be assigned to the spinal anesthesia. This patient received 15 mg. of Pontocaine®, roughly equivalent to 150 mg. of procaine. This is a maximal dose of spinal anesthesia even for abdominal operation in a non-pregnant patient (range for such patients: 6 to 16 mg. of Pontocaine®). And the higher the dosage, the greater is the likelihood of "spinal shock." According to Dr. N. E. Assali, who has studied extensively the relationships of the hemodynamics of pregnancy to spinal anesthesia, two additional factors are operative in pregnancy which make "spinal shock" more likely than in a comparable non-pregnant patient:

(1) There is increased neurogenic tone—that is, maintenance of blood pressure is almost completely under autonomic control, with humoral mechanisms at a minimum. Thus, the blood pressure is more sensitive to autonomic blockade by spinal anesthesia. (It is important to remember that the reverse is true in a *toxemic* pregnant patient, the principal control of blood pressure then being by humoral mechanisms.)

(2) In a pregnant patient, there is pooling of blood in the lower extremities as a result of any lowering of blood pressure by spinal anesthesia. This greatly decreases cardiac output and is the principal factor in the production of spinal anesthesia shock in the non-toxemic pregnant patient. (When toxemia of pregnancy is present this mechanism is inoperative, "spinal shock" rarely occurring.)

From his knowledge of these mechanisms, Dr. Assali makes the flat-footed statement that "*normal pregnant patients (and patients with essential hypertension) should be given a third the amount of spinal anesthetic administered to non-pregnant individuals.*" On this basis, a maximal dose of Pontocaine® would be in the range of 5 mg. Anesthe-

tists generally feel safe in employing 7 to 10 mg., but the latter dose is certainly the upper limit. It is significant to note that the anesthetist with extensive experience of spinal anesthesia in obstetrics tends to use smaller doses than does the debutant in this field.

In this patient, then, over-dosage of spinal anesthetic initiated the tragic terminal chain of events. When shock occurred, the single most important corrective measure was omitted—namely, raising the legs 90 degrees. Even simple Trendelenberg position is of some value, but not sufficient to restore the cardiac output. In the present case the patient was actually "leveled," and there is no mention of any leg-raising maneuver. Dependence was placed instead on vasopressor agents, and they were not adequate to the task of restoring effective circulation of blood volume promptly enough to prevent irreversible damage from the spinal shock.

Elective cesarean section should be, today, an extremely safe operation. But, as this case illustrates, the opportunities for lethal errors of commission and omission are manifold, and are only avoided by thorough familiarity with modern knowledge and meticulous attention to its complete application.